MILK AND LAMB PRODUCTION OF EAST FRIESIAN-CROSS EWES IN NORTHWESTERN WISCONSIN

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Summary

Two ½ East Friesian (EF), one ¾ EF, one ⅞ EF, and several Dorset rams were mated to crossbred ewes from 1993 through 1996. Growth, reproduction, and lactation performance of their progeny were compared. EF-cross lambs had greater birth, weaning, and postweaning weights than Dorset-cross lambs. When lambing at one and two years of age, EF-cross ewes gave birth to and reared more lambs per ewe mated, had longer lactation lengths, produced more milk, fat and protein, and had a lower percentage of milk fat and protein than Dorset-cross ewes. With the levels of EF breeding evaluated in this study (up to 50%), EF-cross sheep are superior to Dorset-cross sheep for lamb and milk production in northwestern Wisconsin.

However, dairy sheep producers should be aware that in many other countries where the EF has been imported to improve commercial milk production of local sheep populations, sheep containing more than 50% EF breeding have had lower survival, lower lamb production, and, in some cases, lower milk production compared to local breeds. Countries that have reported poor performance of high percentage EF sheep are in the Mediterranean region, and it appears that the EF is poorly adapted to the high environmental temperatures of the region. They have also been shown to be more susceptible to some diseases than local breeds; most notably, pneumonia.

Therefore, there is a need for evaluation of pure EF or EF-cross sheep of greater than 50% EF breeding to determine the optimum amount of EF breeding for commercial dairy sheep farms in the north central U.S. Other dairy breeds also should be evaluated as they become available in the U.S.

Introduction

Consumers in the United States have developed a taste for sheep milk cheeses which has been reflected in the steady increase in the amount of imported product in recent years. In 1983, 25 million pounds of sheep milk cheese was imported by the United States, and twelve years later in 1995, sheep milk cheese imports had increased by 180% to 70 million pounds (FAO, 1997). U.S. consumers must rely on imported product because there is very little domestic production.

The United States is without a sheep dairying heritage, but a small domestic industry is developing with the hope of tapping into the growing demand for sheep milk cheeses. Growth in producer numbers has been constant but not dramatic because of limitations in production and marketing. The main production limitation has been low milk yields of domestic breeds. U.S. breeds of sheep have been selected for either lamb or wool production and are relatively poor milk producers. Sakul and Boylan (1992) have reported lactation yields of domestic breeds and their crosses to range from 110 to 175 lb. There are, however, European and Mideast sheep breeds which have been successfully selected for high levels of commercial milk production: 422 lb. for Assaf (Gootwine et al., 1980), 460 lb. for Awassi (Eyal et al., 1978), 484 lb. for Lacaune (Barillet, 1995), and 455 lb. for Lacha (Esteban Munoz, 1982).

The East Friesian is generally regarded as the highest milk producing breed in the world with yields of 1200 to 1400 lb. reported in northern Europe (Sonn, 1979; Kervina et al., 1984). The breed was developed in the East Friesland area of Germany. Its body size is medium to large with rams weighing 200 to 265 lb. and ewes weighing 145 to 165 lb., and they produce 11 to 13 lb. of white wool. Their face and legs are white and free of wool. A distinguishing characteristic is a long, thin tail which is free of wool - a “rat” tail. Over 90% of the ewe lambs will mate at seven months of age to lamb at one year of age. The ewes are very prolific with a 230% lamb crop expected from mature ewes (Kervina et al., 1984).

In the recent past, U.S. animal health regulations prevented the direct importation of sheep, sheep embryos, or ram sperm from most countries. In the early 1990’s, Canada allowed importation of EF semen from Europe, and in more recent years, U.S. flocks enrolled in the Voluntary Scrapie Flock Certification Program have been allowed to import EF animals and semen from a few countries.

In 1993, the University of Wisconsin-Madison, along with the University of Minnesota and a few private breeders, imported the first EF-cross rams into the U.S. from Canada. The Canadian rams were the result of imported European semen. This paper reports the results to date of our evaluation of EF-cross sheep in northwestern Wisconsin. A portion of the data included in this report was summarized and reported in earlier reports by Berger and Thomas (1995, 1997).

Materials and methods

The study was conducted at the Spooner Agricultural Research Station of the University of Wisconsin-Madison located in northwest Wisconsin (latitude: 45˚49´, longitude: 91˚53´, average minimum temperature in January: -19.1˚C, average maximum temperature in July: 27.5˚C). Crossbred ewes of ½ Dorset, ¼ Romanov (or Finnsheep), ¼ Targhee breeding (commercial ewes) were mated to either EF-cross rams or Polled Dorset rams during the late summers or autumns of the four years from 1993 to 1996. Two ½ EF, ½ Rideau rams were used all four years, one ¾ EF, ¼ Rideau ram was used from 1994 to 1996, and one ⅞ EF, ⅛ Rideau ram was used in 1996. The four rams were the result of artificial insemination from semen imported into Canada from Switzerland from three different EF rams. Three polled Dorset rams were used each year, with one or two rams replaced each year. The Dorset rams were purchased from Wisconsin breeders from rams consigned to the Wisconsin Ram Test Station.

Lambs were born from the commercial ewes in the winters or springs of 1994 through 1997 and weaned at approximately 60 days of age. Most female lambs born from 1994 through 1996 were retained as replacements. They were mated to lamb first at approximately 12 months of age and annually thereafter, except ewes born in 1994 were lambed only in 1995. They were mated to ½ EF or ¾ EF rams in the autumn of 1994 and to Dorset rams in the autumns of 1995 and 1996. Lambs born from these ewes were weaned at approximately 60 days of age in 1995 and at approximately 30 days of age in 1996 and 1997. Many of the ewe lambs were retained as replacements.

Lambs were raised in confinement on high concentrate diets. Male lambs were not castrated and marketed at an average age of 140 days at an average live weight of 125 lb.

Matings of the commercial ewes and the Dorset-sired and EF-sired ewes resulted in production of EF crossbred lambs or ewes with a percentage of EF breeding ranging from 12.5% to 50% and of non-EF crossbred lambs and ewes with 75% or 87.5% Dorset breeding.

One- and two-year-old Dorset-sired and EF-sired ewes lambing in 1996 and 1997 nursed their lambs until approximately 30 days of age and were then milked twice per day in an automated milking parlor at 6 a.m. and 5 p.m starting on the day of weaning. Individual daily milk production was determined every 28 days at an evening milking and the milking the following morning. Individual milk samples were taken at the morning milking and analyzed for butterfat and protein percentage by a certified laboratory in both years and for somatic cells in 1997. An estimate of total milk, fat, and protein production for a lactation was calculated using the following formula:

Estimated lactation yield = [production 1st test day x no. days between start of milking and 1st test day] + [(prod. 1st test day + prod. 2nd test day)/2 x no. days between 1st and 2nd test day] + [(prod. 2nd test day + prod. 3rd test day)/2 x no. days between 2nd and 3rd test day] +.....+ [prod. next to last test day + prod. last test day)/2 x no. days between next to last and last test day]+ [prod. last test day x no. days between last test day and end of milking].

Milking was discontinued on a ewe after a testing when the total milk production from both evening and morning milkings fell below .45 lb. Estimated total milk production and lactation length was for the milking period only with no estimate of milk production during the nursing period.

This study included full production year data for the years 1993/94, 1994/95, 1995/96, and 1996/97. Data were analyzed using the GLM procedure of SAS (1995).

Results and discussion

Body weights of lambs sired by EF-cross or Dorset rams from commercial dams and of lambs from EF-sired and Dorset-sired dams born through 1997 are presented in Table 1. At all ages, lambs with an EF-cross sire or dam had heavier ($P < .05$) body weights than lambs with a Dorset sire or Dorset-cross dam. These data indicate that the direct effect of EF genes for growth rate are greater than the direct effect of Dorset genes for growth rate (breed of sire comparisons) and that the combined effect of the direct gene effects for growth and the maternal gene effects for growth through milk production are also greater in the EF compared to the Dorset (breed of dam comparisons). It is not possible to determine the relative magnitude of the EF direct and maternal effects from these data because the “breed of sire” and the “breed of dam” data were collected in different years, with different ages of ewes, and with different weaning ages.

In other studies, where EF genetics was introduced into local populations to increase milk production, crossbred lambs of EF breeding also had greater growth rates than lambs of local breeds (Ricordeau and Flamant, 1969a, in France with the Préalpes du Sud breed; Kalaissakis et al., 1977, in Greece with the Chios breed; Katsaounis and Zygoyiannis, 1986, in Greece with the Karamaniko Katsikas and Karagouniko breeds).

Table 1. Body weights of lambs.

Breed	Number of lambs born	Body weights (lb.) at: Birth	30 days	60 days	140 days (males)
Breed of sire					
EF-cross	420	$11.04 \pm .22^a$		$54.3 \pm .9^a$	131.3 ± 2.9^a
Dorset	216	$9.92 \pm .31^b$		47.7 ± 1.5^b	117.5 ± 4.4^b
Breed of dam					
EF-cross	546	$10.30 \pm .11^a$	$30.8 \pm .4^a$		131.6 ± 2.4^a
Dorset-cross	150	$9.79 \pm .15^b$	$28.6 \pm .7^b$		121.4 ± 3.7^b

[a,b]Within a column and breed of sire or breed of dam, means with a different superscript are different ($P < .05$).

Presented in Table 2 is the reproductive performance of ewes sired by Dorset or EF-cross rams and lambing at one year of age in 1995, 1996 and 1997, and at two years of age in 1997. Young EF-cross ewes had a greater ($P \leq .05$ or $P < .10$) prolificacy and number of lambs reared per ewe lambing and per ewe mated than did young Dorset-cross ewes. Fertility was similar between the two breed groups. The rearing figures do not include the lambs successfully reared on milk replacer (EF-cross dams = 45 lambs, Dorset-cross dams = 5 lambs). Accounting for these lambs would increase the number of lambs reared per ewe lambing and per ewe mated to: EF-cross - 1.83 and 1.76, Dorset-cross - 1.60 and 1.50, respectively.

Greater prolificacy of EF-cross ewes compared to local breed ewes also has been reported by Ricordeau and Flamant (1969a) and Gootwine and Goot (1996, local breed was the Awassi). Kalaissakis et al. (1977) reported that F1 EF-cross ewes were superior and ewes with greater than 50% EF breeding were inferior to local ewes for number of lambs reared per ewe mated.

Table 2. Reproduction of ewes lambing at one and two years of age.

Breed of ewe	**Number of ewes mated**	**Fertility, %**	**Prolificacy, no.**	**Lambs reared/ ewe lambing, no.**	**Lambs reared/ per ewe mated, no.**
EF-cross	338	96.2 ± 1.3^{a}	$1.93 \pm .04^{a}$	$1.69 \pm .05^{c}$	$1.62 \pm .05^{a}$
Dorset	146	93.5 ± 1.7^{a}	$1.66 \pm .06^{b}$	$1.56 \pm .06^{d}$	$1.47 \pm .06^{b}$

Within a column, means with a different superscript are different: $^{a,b}(P \leq .05)$, $^{c,d}(P < .10)$.

Presented in Table 3 is the lactation performance of one-year-old ewes in 1996 and 1997, and two-year-old ewes in 1997. The EF-cross ewes had lactations that were 34 days longer and produced 113 lb. more milk, 4.7 lb. more fat, and 4.9 lb. more protein compared to the Dorset-cross ewes ($P < .05$, Table 3). Fat and protein percentage of milk from Dorset-cross ewes was approximately .5 percentage units higher ($P < .05$) compared to milk from EF-cross ewes. Somatic cell counts were similar between the breed groups and averaged approximately 100,000 cells per ml. of milk.

Higher milk production of crossbred ewes with up to 50% EF breeding compared to local ewes has been reported by Ricordeau and Flamant (1969b), Kalaissakis et al. (1977), and Katsaounis and Zygoyiannis (1986). However, ewes of greater than 50% EF breeding have been reported to produce both less (Kalaissakis et al., 1997) and more (Ricordeau and Flamant, 1969b) milk than local breeds. Gootwine and Goot (1996) found that pure EF and EF-cross ewes were either inferior or similar to Awassi ewes for milk yield. The poor lactation performance of ewes of high percentage EF breeding in these Mediterranean environments is thought to be due to poor adaptability to high temperatures (Boyazoglu, 1991).

In Table 3 the EF-cross ewes were divided into those with ¼ or less EF breeding and those with ⅜ or greater EF breeding, and there was no significant difference between these two EF groups. This does not necessarily mean that increased EF breeding will fail to generate more milk production. What is being measured by this comparison is primarily single ram effects. All the ⅛ and ¼ EF ewes received their EF genes from one of two ½ EF rams, and the vast majority of the ⅜ and ½ EF ewes received their EF genes from one ¾ EF ram. If by chance, the ¾ EF ram had a set of milk production genes that were of similar genetic value to those of the ½ EF rams, we would get the results in Table 3. Given the results of most other studies, we would predict that if we had used a large number of EF rams in this study, the ewes with ⅜ to ½ EF breeding would have produced more milk than the ewes with ⅛ to ¼ EF breeding. The small number of rams used in this study is a major criticism, however, there were very few EF-cross rams available to us in 1993 when this study began.

Table 3. Lactation performance of young EF-cross and Dorset-cross ewes.

Trait	Breed of ewe: Dorset-cross	EF-cross, 1⁄8-1⁄4 EF	EF-cross, 3⁄8-1⁄2 EF
Number of lactations	76	148	98
Lactation length, d	92.7±4.2^{a}	125.9±3.2^{b}	126.7±4.4^{b}
Milk yield, lb.	125.2±12.1^{a}	245.7±9.2^{b}	231.4±13.0^{b}
Fat, %	5.54±.07^{a}	5.04±.06^{b}	5.00±.08^{b}
Fat yield, lb.	7.3±.7^{a}	12.3±.4^{b}	11.7±.7^{b}
Protein, %	5.42±.05^{a}	4.96±.04^{b}	4.98±.05^{b}
Protein, lb.	7.0±.7^{a}	12.1±.4^{b}	11.7±.7^{b}
Log somatic cell count	4.99±.09^{a}	5.03±.05^{a}	5.00±.07^{a}

^{a,b}Within a row, means with a different superscript are different (P < .05).

Lactation performance of ewes of different ages is presented in Table 4. The effects of production year and age of ewe are confounded since one-year-old ewes were present in both 1996 and 1997, and two-year-old ewes were only present in 1996. It appears that ewe management may have been somewhat better in 1997 than in 1996 because one-year-old ewes had higher production in 1997 than in 1996. This may be expected since 1996 was our first year of milking, and the knowledge gained that first year should have resulted in greater production in the second year. Therefore, the production of the two-year-old ewes compared to the average of the one-year-old ewes may be somewhat of an overestimate of the actual age effect. However, given this limitation of the data, the two-year-old ewes had lactations that were 19 days longer and produced 80 lb. more milk, 2.8 lb. more fat, and 4.2 lb. more protein than one-year-old ewes.

Table 4. Lactation performance of one- and two-year-old ewes.

Trait	1996 1-year-olds	1997 1-year-olds	1997 2-year-olds
Number of lactations	127	81	114
Lactation length, d	110.0±3.4^{a}	111.0±4.2^{a}	129.4±3.8^{b}
Milk yield, lb.	170.1±9.7^{d}	198.6±12.1^{e}	264.1±11.0^{f}
Fat, %	5.30±.06^{a}	5.35±.07^{a}	4.82±.07^{b}
Fat yield, lb.	9.1±.5^{a}	10.7±.6^{b}	12.7±.6^{c}
Protein, %	5.05±.04^{a}	5.18±.05^{b}	5.22±.04^{b}
Protein, lb.	8.6±.5^{a}	10.1±.6^{b}	13.6±..5^{c}
Log somatic cell count		4.95±.07^{a}	5.06±.06^{a}

^{a,b,c}Within a row, means with a different superscript are different (P < .05).
^{d,e,f}Within a row, means with a different superscript are different (P < .10).

A note of caution

The results of this study show that EF breeding increases lamb growth, improves ewe reproduction, and increases milk, fat and protein production compared to Dorset breeding. The only negative effect of EF breeding is a lowering of fat and protein percentage. Even though the sample of EF-cross rams was very small, the results are in good agreement with studies conducted in other countries that have compared sheep with up to 50% EF breeding with local breeds. However, producers should not extrapolate these results to sheep of greater than 50% EF breeding. There are a number of reports in the literature of poor viability of pure EF and EF-cross sheep of over 50% EF breeding. Katsaounis and Zygoyiannis (1986) report especially poor viability of EF sheep in Greece. They imported a total of 52 ewes, 10 rams and 18 lambs of EF breeding in the three years of 1956, 1960, and 1965. They were run on their experimental farm along with sheep of the two local breeds. Of these imported animals, all the lambs died within two months, and all the adults had died by 1970. Of the pure EF lambs born in the flock in Greece, 38.3% were stillborn or not viable at birth, 29.6% died before the age of two months, and of those weaned, 69.2% died before one year of age. Ewes of ½ EF breeding lived for a respectable 5.1 years, but ewes of higher percentages of EF breeding had very short lifespans: ¾ EF = 2.6 years, ⅞ EF = 2.7 years, $\frac{15}{16}$ EF = 2.5 years, $\frac{31}{32}$ EF = 2.5 years, and pure EF = 2.0 years. The most common cause of death was pneumonia with a high incidence of Maedi (OPP-like disease) in adult ewes. Ricordeau and Flamant (1969) also reported an increased death loss to respiratory disease of EF-cross lambs in France. In different years and with percentages of EF breeding varying from 50% to 87.5%, they reported a 2.2% to 22.2% increased death loss in EF-cross lambs from pasteurellosis and pneumonia compared to Préalpes du Sud lambs.

Kervina et al. (1984) state; “The East Friesian sheep is not a flock animal. It prefers to be alone and needs individual care. Small flocks of 3 to 8 animals are optimal and a herd should never be larger than 40 head. Larger herds require plenty of space so that the individuals or small families can keep by themselves. They are not suitable to be kept with other breeds.” While this statement was not referenced with scientific studies, it indicates a concern on the part of the authors of the lack of adaptability of the EF to large-flock conditions that probably was the result of their observations or research studies.

The studies where poor performance of sheep of high percentage EF breeding were observed were conducted in Mediterranean environments which are considerably different from the environment of the northcentral U.S. Therefore, similar problems may not arise in our environment. At the Spooner Station we have a small group of ewes that are being upgraded to higher percentages of EF breeding, so we will be able to determine if viability decreases as EF breeding goes beyond 50%.

Future work

In addition to the two ½ EF rams, the ¾ EF ram, and the ⅞ EF ram used to produce the animals discussed in this report, we have purchased a pure EF ram of Dutch breeding via Canada, a pure EF ram of Swedish breeding via New Zealand and New York, frozen semen from three Swedish EF rams via New Zealand, and frozen semen from three Dutch EF rams. We will continue our comparison of EF-sired and Dorset-sired lambs and ewes for two or three more years with the improvement to the study of a larger sample of EF rams and the production of true F1s from both the EF and Dorset sires. We also will have a comparison of three of the major sources of EF bloodlines in North America. In addition, we hope to have frozen semen from three Lacaune rams at the University of Wisconsin-Madison in time for the 1998 breeding season. Our intention is to conduct a comparison of F1 EF and Lacaune lambs and ewes over two or three years.

References

Barillet, F. 1995. Genetic improvement of dairy sheep in Europe. Proc. of Great Lakes Dairy Sheep Symp., Wisconsin Sheep Breeders Cooperative, Madison, Wisconsin. pp. 25-43.

Berger, Y.M. and D.L. Thomas. 1995. Survival, growth and feed efficiency of 1/4 East Friesian lambs. Proc. Great Lakes Dairy Sheep Symp., Wisconsin Sheep Breeders Cooperative, Madison, Wisconsin. pp. 73-76.

Berger, Y.M. and D.L. Thomas. 1997. Early experimental results for growth of East Friesian crossbred lambs and reproduction and milk production of East Friesian crossbred ewes. Proc. 3rd Great Lakes Dairy Sheep Symp., Wisconsin Sheep Breeders Cooperative, Madison, Wisconsin. pp. 12-21.

Boyazoglu, J. 1991. Milk breeds of sheep. In: K. Maijala (Editor), Genetic Resources of Pig, Sheep and Goats. Vol. 12. Elsevier, Amsterdam.

Esteban Munoz, C. 1982. La production de leche de oveja en Espana. Caracteristicas y problematica. Avances en Alimentacion y Mejora Animal 23:259-273.

Eyal, E., A. Lawi, Y. Folman, and M. Morag. 1978. Lamb and milk production of a flock of dairy ewes under an accelerated breeding regime. J. Agric. Sci., Camb. 91:69-79.

FAO. 1997. Food and Agriculture Organization of the United Nations. World Wide Web Site. FAOSTAT Database Collections: (http://apps.fao.org/lim500/agri_db.pl).

Gootwine, E., B. Alef, and S. Gadeesh. 1980. Udder conformation and its heritability in the Assaf (AwassixEast Friesian) cross of dairy sheep in Israel. Ann. Gen. Sel. Anim. 12:9-13.

Gootwine, E. and H. Goot. 1996. Lamb and milk production of Awassi and East-Friesian sheep and their crosses under Mediterranean environment. Small Rum. Res. 20:255-260.

Kalaissakis, P., T. Papadimitriou, J.C. Flamant, J.G. Boyazoglu, and N. Zervas. 1977. Comparison des races ovines Chios et Frisonne avec leurs croisements en Grèce continentale. II. Production laitière. Ann. Génét. Sél. Anim. 9:181-201.

Katsaounis, N. and D. Zygoyiannis. 1986. The East Friesland sheep in Greece. Res. and Develop. in Agric. 3:19-30.

Kervina, F., R. Sagi, R. Hermelin, B. Galovic, S. Mansson, I. Rogelj, and B. Sobar. 1984. Alfa-Laval. 1984. System Solutions for Dairy Sheep. 2nd edition. Alfa-Laval Agri International AB, Tumba, Sweden.

Ricordeau, G. and J.C. Flamant. 1969a. Croisements entre les races ovines Préalpes du Sud et Frisonne (Ostfriesisches Milchschaf). II. Reproduction, viabilité, croissance, conformation. Ann. Zootech. 18:131-149.

Ricordeau, G. and J.C. Flamant. 1969b. Croisements entre les races ovines Préalpes du Sud et Frisonne (Ostfriesisches Milchschaf). III. Performances laitières. Ann. Zootech. 18:131-149.

Sakul, H. and W.J. Boyaln. 1992. Evaluation of U.S. sheep breeds for milk production and milk composition. Small Ruminant Res. 7:195-201.

SAS Institute Inc. 1995. SAS/STAT User's Guide. Version 6.11. SAS Institute Inc. Cary, North Carolina.

Sonn, H. 1979. Vaches et brebis laitières en République Fedèrale d'Allemagne. La Tech. Laitière. 407:9-10.